



Plant Community Composition and Structure Monitoring for Wind Cave National Park

2016 Data Report

Natural Resource Data Series NPS/NGPN/NRDS—2017/1090



**ON THIS PAGE**

Overview of Plant Community Composition and Structure Monitoring plot PCM_WICA_0004 at Wind Cave National Park, June 2016.

Photograph courtesy of the National Park Service.

ON THE COVER

Plant Community Composition and Structure Monitoring plot PCM_WICA_0031 at Wind Cave National Park, June 2016.

Photograph courtesy of the National Park Service.

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Abstract

This report presents the results of vegetation monitoring efforts in 2016 at Wind Cave National Park (WICA) by the Northern Great Plains Inventory and Monitoring Network (NGPN) and the Northern Great Plains Fire Effects (NGPFire) program.

During the sixth full year of field work, the NGPN field crew visited eighteen long-term plant community monitoring (PCM) plots to collect data on the plant communities at WICA. The NGPFire crew visited an additional ten PCM plots and ten fire plant community monitoring plots (FPCM) plots. This is part of a long-term monitoring effort to better understand the condition of the mixed-grass prairie and ponderosa pine woodlands within the boundaries of WICA. NGPN staff captured data relating to species richness, herb-layer height, abundances of native and non-native species, ground cover, and site disturbance from each PCM plot. In plots where woody species were present, NGPN measured tree regeneration, tall shrub and tree density, and woody fuel load. The NGPFire crew collected data relating to herb-layer height, abundance of native and non-native species, ground cover, and target species data at ten PCM plots and two FPCM plots. In five FPCM plots, only woody species and target species data were collected, and in three FPCM plots only target species data were collected.

Our 2016 findings can be summarized as follows: Monitoring crews identified 215 species in 38 monitoring plots visited in 2016 at WICA, of which 26 were exotic species. Common buckthorn (*Rhamnus cathartica*), a targeted exotic species of concern in Northern Great Plains Network parks, was identified in two plots at WICA. The average relative cover of exotic species was approximately 25%. Tree density, health, and seedling regeneration, as well as woody fuel loads, were observed at twenty-eight plots. The most common disturbances observed were related animal use (e.g., grazing, game trails, and prairie dogs) and fire (wildland and prescribed).

Acknowledgments

We thank all the authors of the NGPN Plant Community Monitoring Protocol, particularly A. Symstad, for outstanding guidance on data collection and reporting. Thank you to the staff at WICA, particularly T. Richardson, for providing logistical support. We also thank M. Bynum for assistance in the field. The 2016 NGPN vegetation field crew of C. Davis, S. Rockwood, W. Vogel, M. Davis, I. Ashton, L. Mickelson, L. LaFleur, and K. Rugg, with the assistance of the Northern Great Plains Fire Effects crew of D. Swanson, E. Watson, I. Muirhead, and C. Tomford, collected all the data included in this report.

Introduction

Wind Cave National Park (WICA), located in the southern Black Hills of South Dakota, was established in 1903 with a purpose to protect the unique Wind Cave resources. Over the years the park has grown in size to preserve and enhance the mixed-grass prairie and native wildlife, while also providing for the enjoyment of the public. The 33,851 acres of WICA is a mosaic of ponderosa pine forest and mixed-grass prairie, with approximately 30% covered by ponderosa pine forests. While some areas have high exotic species cover, the native plant communities within the upland areas of WICA are considered to be in good condition (Komp et al. 2011). Vegetation monitoring began at WICA in 1997 by the Northern Great Plains Fire Ecology Program (NGPFire) (Wienk et al. 2011). In 2011, the Northern Great Plains Inventory & Monitoring Program (NGPN) combined efforts with NGPFire (Ashton et al. 2012) to establish a coordinated vegetation monitoring protocol, and plot locations were shifted to better represent the entire park (Symstad et al. 2012b), based on the 2010 boundary. Additional upland plots were later added to represent a 2011 addition to the park property. There is a separate effort to monitor streambank condition because riparian communities are an important resource for the park (Burkhart and Kovacs 2013). In this report, we provide summaries of the data collected at 38 plots visited in 2016. Please refer to the “Northern Great Plains Fire Ecology Annual Report: Calendar Year 2016” for park burn unit analysis and interpretation of the 2016 monitoring results accessible on the Data Store <https://irma.nps.gov/DataStore>.

Methods

The NGPN Plant Community Composition and Structure Monitoring Protocol (Symstad et al. 2012b, a) describes in detail the methods used for sampling long-term plots. Below, we briefly describe the general approach. For those interested in more detail, please see the protocol publications cited above, and available at <http://science.nature.nps.gov/im/units/ngpn/monitor/plants.cfm>.

NGPN and NGPFire Monitoring Plots 2016

The NGPN and NGPFire implemented a survey to monitor plant community structure and composition in WICA using a spatially balanced probability design (Generalized Random Tessellation Stratified [GRTS]; Stevens and Olsen 2003, 2004). Using the GRTS design, NGPN selected 35 randomly located sites within WICA to install Plant Community Monitoring (PCM) plots. These 35 sites are split into five panels containing seven sites each. NGPN crews visit two panels (14 sites total) every year using a rotating sampling scheme, and after five years all 35 sites ideally will have been visited twice. In 2016, NGPN crews visited sites in panel 1 and panel 5 (Figure 1) during late June and early July (Table 1). Data from these randomly selected sites can be used to estimate condition of vegetation communities for the whole park and, over time, can be used to discern trends in condition. Ten additional monitoring sites (2 per panel) were selected within the 2011 park addition, and are scheduled to be visited on the same schedule as above, as time allows. From these plots, an additional four PCM plots were visited by NGPN in 2016.

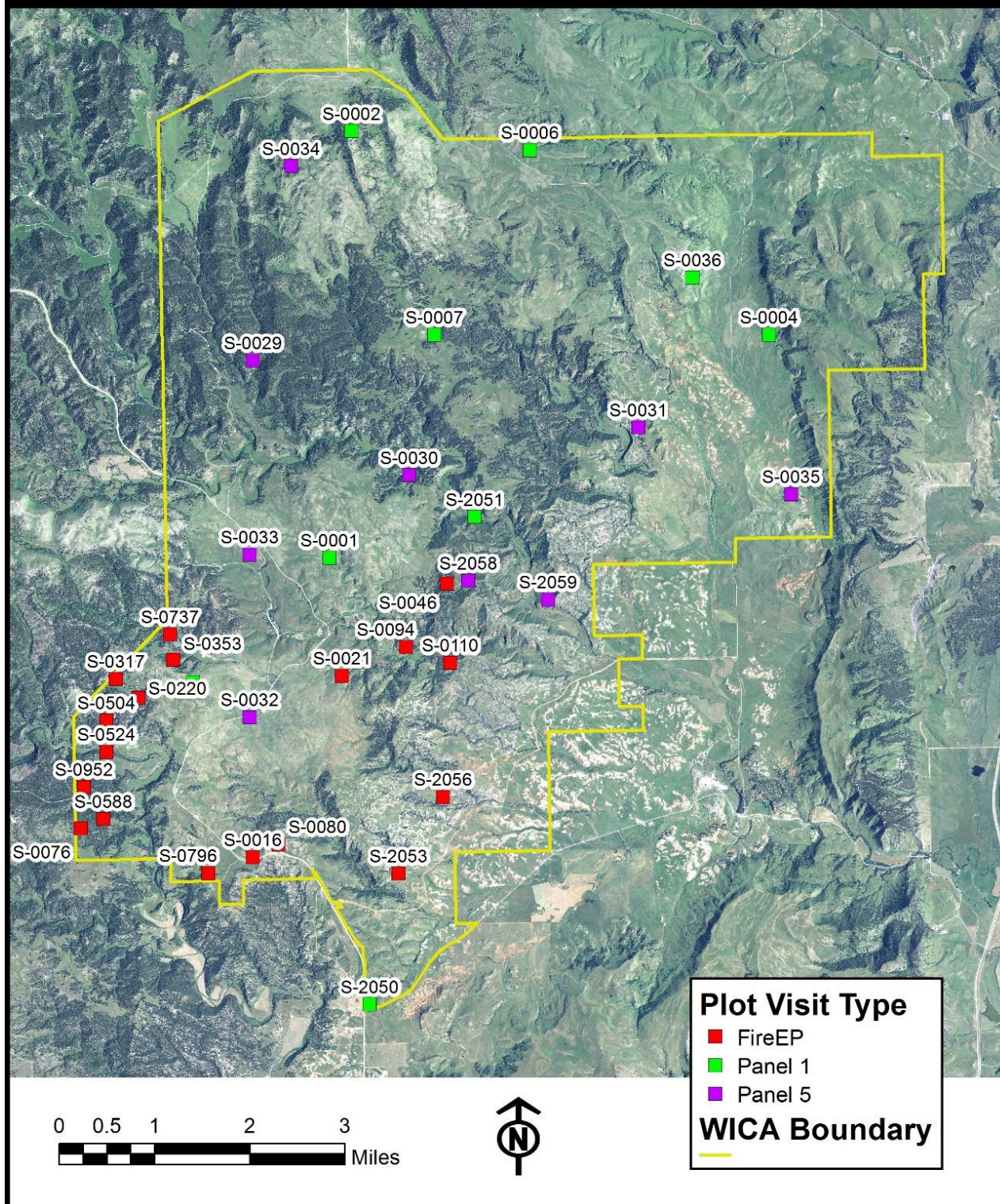


Figure 1. Map of Wind Cave National Park (WICA) plant community monitoring (PCM) plots visited in 2016. Nine Panel 1 plots (in green) and Nine Panel 5 plots (in purple) were monitored in 2016 by NGPN. Twenty additional plots were visited in 2016 by NGPFire (in red).

Table 1. Field journal for Northern Great Plains Network plant community monitoring (PCM) at Wind Cave National Park (WICA) in 2016. Two crews of ~4 people completed 18 PCM plots. (* not always recorded)

Date	Plots Read	Time at Plot (hrs.)*	Notes
Wednesday June 22, 2016	PCM_0031	2.5	4 person crew
	PCM_0004	2.5	4 person crew
	PCM_0032	–	4 person crew
	PCM_0033	–	4 person crew
Thursday June 23, 2016	PCM_0006	2	4 person crew
	PCM_0036	3.5	4 person crew
	PCM_0005	–	4 person crew
Monday June 27, 2016	PCM_0034	5	4 person crew
	PCM_0007	–	4 person crew
Tuesday June 28, 2016	PCM_0029	4	4 person crew
	PCM_0002	3	4 person crew; Partial read: chased off plot by bison, completed 6/30
Wednesday June 29, 2016	PCM_2050	3	4 person crew
	PCM_0001	2.5	4 person crew
Thursday June 30, 2016	PCM_0002	2.25	4 person crew
	PCM_2051	6	4 person crew; Challenging plot- thick trees and steep slope
Tuesday July 5, 2016	PCM_0030	–	4 person crew
	PCM_0035	–	3 person crew
Wednesday July 6, 2016	PCM_2058	–	3 person crew
	PCM_2059	–	4 person crew

When a PCM plot was located within an active burn unit, NGPFire added additional visits based on a preburn, 1, 2, 5, and 10 year post-burn sampling schedule using the same GRTS sampling schema. NGPFire established a number of new sites focused in active burn units, and from 2011-2015, twenty-five Fire Plant Community Monitoring (FPCM) plots were established and monitored. In 2016, the NGPFire crew visited ten PCM plots from various sampling panels, plus an additional 10 FPCM plots, during June and September 2016 (Table 2).

Table 2. Field journal for Northern Great Plains Fire Effects Program visits to plant community monitoring (PCM) plots at Wind Cave National Park (WICA) in 2016. Plant community monitoring was completed using a crew of four people. (*2016 Northern Great Plains Fire Ecology Annual Report contain detailed information on changes to vegetative composition and cover following prescribed fire as well as fire objectives, progression, weather, behavior, smoke, and plot analysis.)

Date	Plots Read	Burn Unit	Monitoring Status
June 20, 2016	WICA_FPCM_0220	Cold Brook North	Year 2 post-burn
June 22, 2016	WICA_FPCM_0268	Cold Brook North	Year 2 post-burn
June 20, 2016	WICA_FPCM_0317	Cold Brook North	Year 2 post-burn
June 21, 2016	WICA_FPCM_0353	Cold Brook North	Year 2 post-burn
June 22, 2016	WICA_FPCM_0504	Cold Brook North	Year 2 post-burn

Date	Plots Read	Burn Unit	Monitoring Status
June 21, 2016	WICA_FPCM_0737	Cold Brook North	Year 2 post-burn
June 27, 2016	WICA_PCM_0076	Cold Brook South	Year 2 post-burn
June 29, 2016	WICA_PCM_0120	Cold Brook South	Year 2 post-burn
June 28, 2016	WICA_FPCM_0524	Cold Brook South	Year 2 post-burn
June 27, 2016	WICA_FPCM_0588	Cold Brook South	Year 2 post-burn
June 28, 2016	WICA_FPCM_0796	Cold Brook South	Year 2 post-burn
June 29, 2016	WICA_FPCM_0952	Cold Brook South	Year 2 post-burn
August 23, 2016	WICA_PCM_0016	Bison Flats	Year 2 post-burn
September 29, 2016	WICA_PCM_0080	Bison Flats	Year 2 post-burn
September 29, 2016	WICA_PCM_0021	Canyon	Year 2 post-burn
September 29, 2016	WICA_PCM_0110	Canyon	Year 2 post-burn
September 20, 2016	WICA_PCM_0046	Canyon North	Year 2 post-burn
September 20, 2016	WICA_PCM_0094	Canyon North	Year 2 post-burn
September 14, 2016	WICA_PCM_2053	New Addition	Year 2 post-burn
September 14, 2016	WICA_PCM_2056	New Addition	Year 2 post-burn

Plot Layout and Sampling

At each site visited, NGPN teams recorded plant species cover and frequency in a rectangular, 50 m x 20 m (0.1 ha), permanent plot (Figure 2). Data on ground cover, herb-layer height (≤ 2 m), and plant cover were collected along two 50 m transects (the long sides of the plot) using a point-intercept method (Figure 3). At 50 locations along each transect, once every meter, a pole was dropped to the ground and all species that touched the pole were recorded, along with ground cover and the height of the tallest/first plant intercepted (Figure 3). Species richness data from the point-intercept method were supplemented with species presence data collected from five (1 m²) quadrats located systematically along each transect (Figure 2). At plots visited by NGPFire, only point-intercept data were collected when plant species cover data was necessary. NGPFire collected cover data from twelve of the twenty plots they visited in 2016.

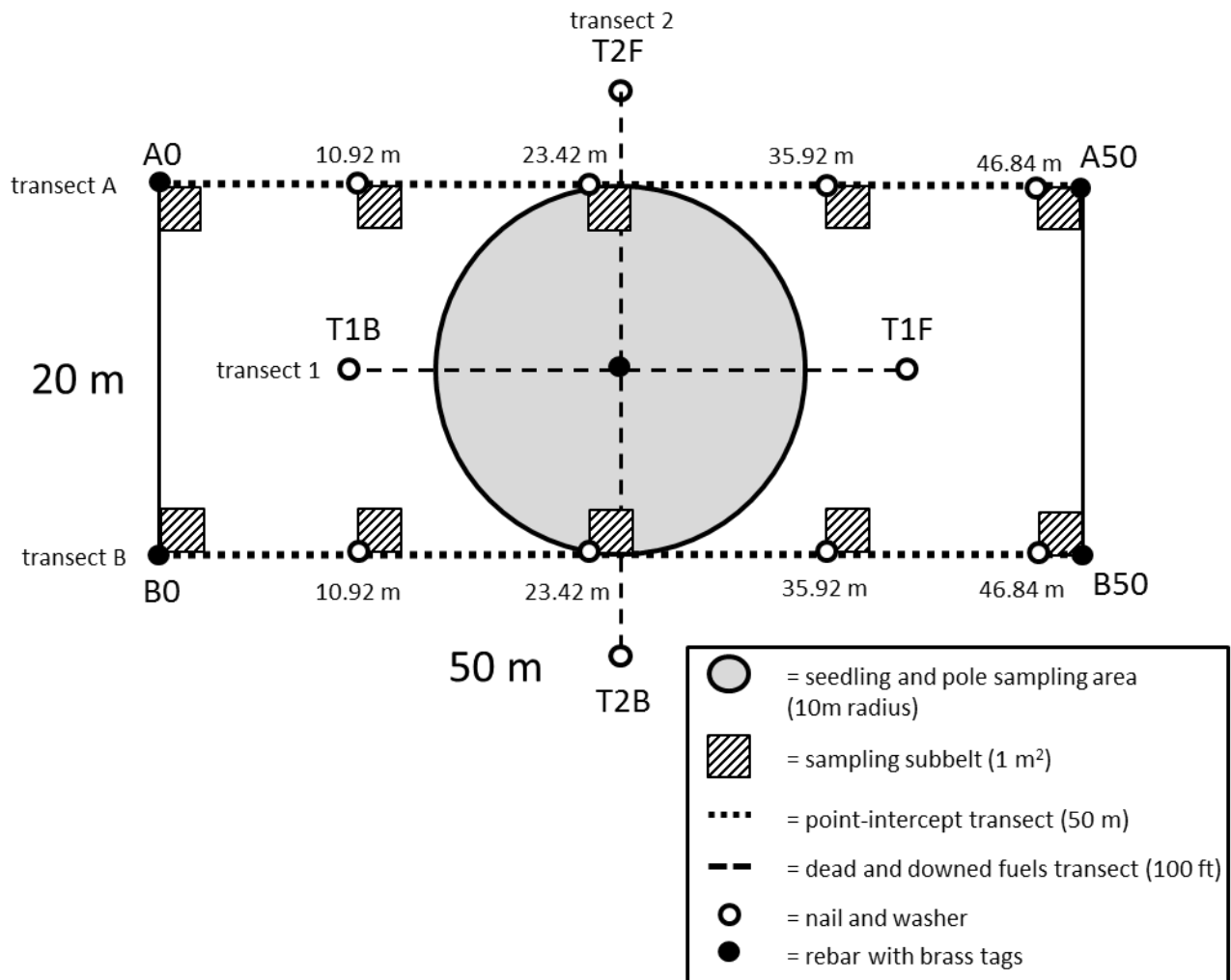


Figure 2. Long-term monitoring plot layout used for sampling vegetation in Wind Cave National Park.

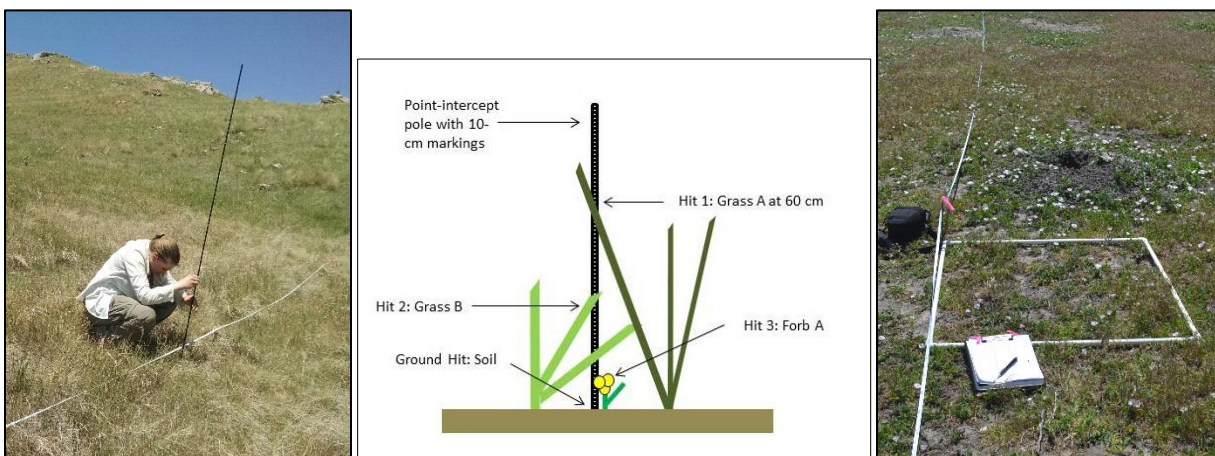


Figure 3. The Northern Great Plains Inventory & Monitoring vegetation crew used point-intercept (left and center panel) and 1m² quadrats (right panel) to document plant diversity and abundance.

When woody species were also present in PCM and FPCM plots, tree regeneration and tall shrub density data were collected within a 10 m radius subplot centered in the larger 50 m x 20 m plot (Figure 2). Trees with diameter at breast height (DBH, 137 cm from the ground) > 15 cm, located within the entire 0.1 ha plot, were mapped and tagged. For each tree, the species, DBH, status (live or dead), and condition (e.g., leaf-discoloration, insect-damaged, etc.) were recorded. Dead and downed woody fuel load data were also collected at these forested plots along two perpendicular, 100 foot (30.49 m) transects with midpoints at the center of the plot (Figure 2), following Brown's Line methods (Brown 1974, Brown et al. 1982).

At each PCM plot visited by NGPN, common disturbances and target species of interest were assessed and documented. Common disturbances include prairie dog towns, animal trails, and fire occurrence. For each disturbance type, the severity and approximate area (m²) was recorded. The NGPN crew also surveyed the area for early-detection exotic species that have the potential to spread into the park and cause significant ecological impacts (Table 3). These species were chosen in collaboration with the Midwest Invasive Plant Network, the Exotic Plant Management Team, park managers, and local weed experts. For each target species present, an abundance class was given on a scale from 1-5, where 1 = one individual, 2 = few individuals, 3 = cover of 1-5%, 4 = cover of 5-25%, and 5 = cover > 25% of the plot. The information gathered from this procedure is critical for early detection and rapid response to such threats. In addition, NGPN noted the presence of plant species that are considered rare or vulnerable to loss in South Dakota, and which may potentially occur in WICA (Table 4). NGPFire included a separate target exotic species search in their site visits, looking for known-invaders, especially common in post-burn sites, including common mullein (*Verbascum thapsis*), Canada thistle (*Cirsium arvense*), and annual bromes (*Bromus spp.*) (Table 5).

Table 3. Exotic species surveyed for at Wind Cave National Park as part of the early detection and rapid response program within the Northern Great Plains Network.

Scientific Name	Common Name	Habitat
<i>Alliaria petiolata</i>	garlic mustard	Riparian
<i>Polygonum cuspidatum</i> ; <i>P. sachalinense</i> ; <i>P. x bohemicum</i>	knotweeds	Riparian
<i>Pueraria montana</i> var. <i>lobata</i>	kudzu	Riparian
<i>Iris pseudacorus</i>	yellow iris	Riparian
<i>Ailanthus altissima</i>	tree of heaven	Riparian
<i>Lepidium latifolium</i>	perennial pepperweed	Riparian
<i>Arundo donax</i>	giant reed	Riparian
<i>Rhamnus cathartica</i>	common buckthorn	Riparian
<i>Heracleum mantegazzianum</i>	giant hogweed	Riparian
<i>Centaurea solstitialis</i>	yellow star thistle	Upland
<i>Hieracium aurantiacum</i> ; <i>H. caespitosum</i>	orange and meadow hawkweed	Upland
<i>Isatis tinctoria</i>	Dyer's woad	Upland
<i>Taeniatherum caput-medusae</i>	medusahead	Upland
<i>Chondrilla juncea</i>	rush skeletonweed	Upland
<i>Gypsophila paniculata</i>	baby's breath	Upland
<i>Centaurea virgata</i> ; <i>C. diffusa</i>	knapweeds	Upland
<i>Linaria dalmatica</i> ; <i>L. vulgaris</i>	toadflax	Upland

Scientific Name	Common Name	Habitat
<i>Euphorbia myrsinites</i> & <i>E. cyparissias</i>	myrtle spurge	Upland
<i>Dipsacus fullonum</i> & <i>D. laciniatus</i>	common teasel	Upland
<i>Salvia aethiopis</i>	Mediterranean sage	Upland
<i>Ventenata dubia</i>	African wiregrass	Upland

Table 4. Rare species surveyed for during the 2016 field season at Wind Cave National Park.

Scientific Name	Common Name
<i>Achnatherum robustum</i>	sleepy grass
<i>Botrychium campestre</i>	prairie moonwort
<i>Botrychium lineare</i>	narrowleaf grapefern
<i>Botrychium simplex</i>	little grapefern
<i>Clematis hirsutissima</i>	hairy clematis
<i>Cryptantha cana</i>	silver-mounded candleflower
<i>Cypripedium parviflorum</i>	lesser yellow lady's slipper
<i>Echinocereus viridiflorus</i>	nylon hedgehog cactus
<i>Elymus diversiglumis</i>	interrupted wildrye
<i>Ericameria parryi</i>	Parry's rabbitbrush
<i>Erigeron acris</i>	bitter fleabane
<i>Erigeron ochroleucus</i>	buff fleabane
<i>Ipomopsis spicata</i>	spiked ipomopsis
<i>Phleum alpinum</i>	alpine timothy
<i>Physaria arenosa</i>	sidesaddle bladderpod
<i>Thelesperma megapotamicum</i>	Hopi tea
<i>Townsendia exscapa</i>	Easter daisy
<i>Townsendia hookeri</i>	Hooker's Townsend daisy
<i>Viburnum edule</i>	squashberry

Table 5. Common known-invading exotic species surveyed for by NGPFire during the 2016 field season at Wind Cave National Park.

Scientific Name	Common Name
<i>Bromus inermis</i>	smooth brome
<i>Bromus japonicus</i>	Japanese brome
<i>Bromus tectorum</i>	cheatgrass
<i>Carduus nutans</i>	musk thistle
<i>Centaurea solstitialis</i>	yellow star thistle
<i>Cirsium arvense</i>	Canada thistle
<i>Cirsium vulgare</i>	bull thistle
<i>Onopordum acanthium</i>	Scotch thistle
<i>Cynoglossum officinale</i>	houndstongue
<i>Verbascum thapsus</i>	common mullein

Data Management and Analysis

FFI (FEAT/FIREMON Integrated; <http://frames.gov/ffi/>) was used as the primary software environment for managing the sampling data. This database is used by a variety of agencies (e.g., NPS, USDA Forest Service, U.S. Fish and Wildlife Service), has a national-level support system, and generally conforms to the [Natural Resource Database Template](#) standards established by the Inventory and Monitoring Program. Species scientific names, codes, and common names are from the USDA Plants Database (USDA-NRCS 2012). However, nomenclature follows the [Integrated Taxonomic Information System](#) (ITIS). In the few cases where ITIS recognizes a new name that was not in the USDA Plants database, the new name was used and a unique plant code was assigned. The conservation status ranks of plant species in South Dakota is determined by the South Dakota Natural Heritage Program (SDNHP). For the purpose of this report, a species was considered rare if its conservation status rank was S1, S2, or S3. See Table 6 for a detailed definition of each conservation status rank.

Table 6. Definitions of state and global species conservation status ranks.*

Status Rank	Category	Definition
S1/G1	Critically imperiled	Due to extreme rarity (5 or fewer occurrences) or other factor(s) making it especially vulnerable to extirpation.
S2/G2	Imperiled	Due to rarity resulting from a very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation.
S3/G3	Vulnerable	Due to a restricted range, relatively few populations (often 80 or fewer), recent widespread declines, or other factors making it vulnerable to extirpation.
S4/G4	Apparently secure	Uncommon but not rare; some cause for concern due to declines or other factors.
S5/G5	Secure	Common, widespread and abundant.
S#S#/ G#G#	Range rank (e.g. S2S3)	Used to indicate uncertainty about the status of the species or community. Ranges cannot skip more than one rank.

*Adapted from NatureServe status assessment table (<http://www.natureserve.org/conservation-tools/conservation-status-assessment>)

After data for the sites were entered, 100% of records were verified to the original data sheet to minimize transcription errors. A further 10% of records were reviewed a second time. After all data were entered and verified, automated queries were used to check for errors in the data. When errors were identified by the crew or the automated queries, changes were made to the original datasheets and the FFI database as needed. Data summaries were produced using the FFI reporting and query tools. Species diversity was measured by looking at species richness, which is simply a count of the species recorded in an area. Absolute cover was calculated from the point-intercept method, and is the total number of vegetation intercepts. This is often greater than 100% because more than one species can be intercepted per point due to overlapping vegetation. Relative cover is then calculated by dividing the absolute cover by the total absolute cover of the grouping of interest (native and exotic species in this report), and is therefore constrained between 0 and 100%.

Results

There are 871 vascular plant species on the WICA species list, and monitoring crews found 215 of these species in 2016 (Table 7). Of these plant species, 26 are exotic species at WICA. A majority of exotic plants identified were either forbs or graminoids (grasses, sedges, and rushes). The exception was common buckthorn (*Rhamnus cathartica*), a target exotic species recorded in two plots: WICA_PCM_0030 with a few individuals, and WICA_PCM_2051 with one individual. Two plant species identified in the PCM and FPCM plots visited in 2016 are listed as rare, though not critically imperiled, in South Dakota: buff fleabane (*Erigeron ochroleucus*) and nylon hedgehog cactus (*Echinocereus viridiflorus*) (Figure 4).

Table 7. List of all plant species identified in WICA long-term plant community monitoring plots in 2016. The species are grouped by plant family. An “X” in the exotic column means that species is not native to the park, or, in the case where only the genus was identified, there are some species within that genus that are exotic. Species that are rare in South Dakota are marked, and the state conservation ranks are provided. Conservation rank definitions are in Table 6 of the report.

Family	Symbol	Scientific Name	Common Name	Exotic	Rare
Agavaceae	YUGL	<i>Yucca glauca</i>	soapweed yucca		
Anacardiaceae	RHAR4	<i>Rhus aromatica</i>	fragrant sumac		
	RHTR	<i>Rhus trilobata</i>	skunkbush sumac		
	TORY	<i>Toxicodendron rydbergii</i>	western poison ivy		
Apiaceae	MUTE3	<i>Musineon tenuifolium</i>	slender wildparsley		
Asclepiadaceae	ASOV	<i>Asclepias ovalifolia</i>	oval-leaf milkweed		
	ASPU	<i>Asclepias pumila</i>	plains milkweed		
	ASST	<i>Asclepias stenophylla</i>	slimleaf milkweed		
	ASVI	<i>Asclepias viridiflora</i>	green comet milkweed		
Asteraceae	ACMI2	<i>Achillea millefolium</i>	common yarrow		
	AGGL	<i>Agoseris glauca</i>	pale agoseris		
	AMPS	<i>Ambrosia psilostachya</i>	Cuman ragweed		
	ANMI3	<i>Antennaria microphylla</i>	littleleaf pussytoes		
	ANNE	<i>Antennaria neglecta</i>	field pussytoes		
	ANPA4	<i>Antennaria parvifolia</i>	small-leaf pussytoes		
	ANTEN	<i>Antennaria sp.</i>	pussytoes		
	ARCA12	<i>Artemisia campestris</i>	field sagewort		
	ARDR4	<i>Artemisia dracunculus</i>	tarragon		
	ARFR4	<i>Artemisia frigida</i>	prairie sagewort		
	ARLU	<i>Artemisia ludoviciana</i>	white sagebrush		
	BREU	<i>Brickellia eupatorioides</i>	false boneset		
	CIAR4	<i>Cirsium arvense</i>	Canada thistle	X	
	CIUN	<i>Cirsium undulatum</i>	wavyleaf thistle		
	CIVU	<i>Cirsium vulgare</i>	bull thistle	X	
	COCA5	<i>Conyza canadensis</i>	Canadian horseweed		
	CORA4	<i>Conyza ramosissima</i>	dwarf horseweed		
	ECAN2	<i>Echinacea angustifolia</i>	blacksamson echinacea		
	ERCA4	<i>Erigeron canus</i>	hoary fleabane		
	ERFL	<i>Erigeron flagellaris</i>	trailing fleabane		
	EROC	<i>Erigeron ochroleucus</i>	buff fleabane		S3/S4
	ERSU2	<i>Erigeron subtrinervis</i>	threenerve fleabane		

Family	Symbol	Scientific Name	Common Name	Exotic	Rare
Asteraceae (continued)	GRSQ	<i>Grindelia squarrosa</i>	curlycup gumweed		
	GUSA2	<i>Gutierrezia sarothrae</i>	broom snakeweed		
	HELIA3	<i>Helianthus sp.</i>	sunflower		
	HEPA19	<i>Helianthus pauciflorus</i>	stiff sunflower		
	HEVI4	<i>Heterotheca villosa</i>	hairy false goldenaster		
	LASE	<i>Lactuca serriola</i>	prickly lettuce	X	
	LIPU	<i>Liatis punctata</i>	dotted blazing star		
	LOAR5	<i>Logfia arvensis</i>	field cottonrose	X	
	LYJU	<i>Lygodesmia juncea</i>	rush skeletonplant		
	MUOB99	<i>Mulgedium oblongifolium</i>	blue lettuce		
	PAPL12	<i>Packera plattensis</i>	prairie groundsel		
	PSMA11	<i>Pseudognaphalium macounii</i>	Macoun's cudweed		
	RACO3	<i>Ratibida columnifera</i>	upright prairie coneflower		
	SOMI2	<i>Solidago missouriensis</i>	Missouri goldenrod		
	SOMO	<i>Solidago mollis</i>	velvety goldenrod		
	SONE	<i>Solidago nemoralis</i>	gray goldenrod		
	SORI2	<i>Solidago rigida</i>	stiff goldenrod		
	SOSP2	<i>Solidago speciosa</i>	showy goldenrod		
	SYFA	<i>Symphyotrichum falcatum</i>	white prairie aster		
	SYLA3	<i>Symphyotrichum laeve</i>	smooth blue aster		
	SYMPH4	<i>Symphyotrichum sp.</i>	aster		
	SYOB	<i>Symphyotrichum oblongifolium</i>	aromatic aster		
	TAOF	<i>Taraxacum officinale</i>	common dandelion	X	
	TEAC	<i>Tetraneuris acaulis</i>	stemless four-nerve daisy		
	TRDU	<i>Tragopogon dubius</i>	yellow salsify	X	
	XASP99	<i>Xanthisma spinulosum</i>	lacy tansyaster		
Boraginaceae	CYOF	<i>Cynoglossum officinale</i>	houndstongue	X	
	LAOC3	<i>Lappula occidentalis</i>	flatspine stickseed		
	LIIN2	<i>Lithospermum incisum</i>	narrowleaf stoneseed		
	MELA3	<i>Mertensia lanceolata</i>	prairie bluebells		
Brassicaceae	ONBE	<i>Onosmodium bejariense</i>	soft-hair marblesseed		
	ALDE	<i>Alyssum desertorum</i>	desert madwort	X	
	ARHI	<i>Arabis hirsuta</i>	hairy rockcress		
	CAMI2	<i>Camelina microcarpa</i>	littlepod false flax	X	
	DEPI	<i>Descurainia pinnata</i>	western tansymustard		
	DRRE2	<i>Draba reptans</i>	Carolina draba		
	ERCA14	<i>Erysimum capitatum</i>	sanddune wallflower		
	ERYSI	<i>Erysimum sp.</i>	wallflower	X	
	LEDE	<i>Lepidium densiflorum</i>	common pepperweed		
	PHLU99	<i>Physaria ludoviciana</i>	foothill bladderpod		
	SIAL2	<i>Sisymbrium altissimum</i>	tall tumbledmustard	X	
Cactaceae	THAR5	<i>Thlaspi arvense</i>	field pennycress	X	
	ECVI2	<i>Echinocereus viridiflorus</i>	nylon hedgehog cactus		S3
	ESCOB	<i>Escobaria sp.</i>	foxtail cactus		
	OPFR	<i>Opuntia fragilis</i>	brittle pricklypear		
	OPMA2	<i>Opuntia macrorhiza</i>	twistspine pricklypear		
	OPPO	<i>Opuntia polyacantha</i>	plains pricklypear		

Family	Symbol	Scientific Name	Common Name	Exotic	Rare
	OPUNT	<i>Opuntia sp.</i>	pricklypear		
Campanulaceae	CARO2	<i>Campanula rotundifolia</i>	bluebell bellflower		
	TRPE4	<i>Triodanis perfoliata</i>	clasping Venus' looking-glass		
Caprifoliaceae	SYOC	<i>Symphoricarpos occidentalis</i>	western snowberry		
Caryophyllaceae	CEAR4	<i>Cerastium arvense</i>	field chickweed		
	PADE4	<i>Paronychia depressa</i>	spreading nailwort		
	SIAN2	<i>Silene antirrhina</i>	sleepy silene		
	SIDR	<i>Silene drummondii</i>	Drummond's campion		
	SILA21	<i>Silene latifolia</i>	bladder campion	X	
	SINO	<i>Silene noctiflora</i>	nightflowering silene	X	
Chenopodiaceae	CHENO	<i>Chenopodium sp.</i>	goosefoot	X	
Cistaceae	HEBI2	<i>Helianthemum bicknellii</i>	hoary frostweed		
Commelinaceae	TRBR	<i>Tradescantia bracteata</i>	longbract spiderwort		
	TROC	<i>Tradescantia occidentalis</i>	prairie spiderwort		
Cupressaceae	JUCO6	<i>Juniperus communis</i>	common juniper		
	JUSC2	<i>Juniperus scopulorum</i>	Rocky Mountain juniper		
Cyperaceae	CABR10	<i>Carex brevior</i>	shortbeak sedge		
	CADU6	<i>Carex duriuscula</i>	needleleaf sedge		
	CAFI	<i>Carex filifolia</i>	threadleaf sedge		
	CAIN9	<i>Carex inops</i>	long-stolon sedge		
	CAPR5	<i>Carex praegracilis</i>	clustered field sedge		
	CAREX	<i>Carex sp.</i>	sedge		
Dryopteridaceae	CYFR2	<i>Cystopteris fragilis</i>	brittle bladderfern		
Euphorbiaceae	EUSP	<i>Euphorbia spathulata</i>	warty spurge		
Fabaceae	AMCA6	<i>Amorpha canescens</i>	leadplant		
	ASAG2	<i>Astragalus agrestis</i>	purple milkvetch		
	ASCR2	<i>Astragalus crassicaupus</i>	groundplum milkvetch		
	ASFL2	<i>Astragalus flexuosus</i>	flexile milkvetch		
	ASGI5	<i>Astragalus gilviflorus</i>	plains milkvetch		
	ASGR3	<i>Astragalus gracilis</i>	slender milkvetch		
	ASLA27	<i>Astragalus laxmannii</i>	Laxmann's milkvetch		
	ASTRA	<i>Astragalus sp.</i>	milkvetch		
	DACA7	<i>Dalea candida</i>	white prairie clover		
	DAPU5	<i>Dalea purpurea</i>	purple prairie clover		
	GLLE3	<i>Glycyrrhiza lepidota</i>	American licorice		
	MELU	<i>Medicago lupulina</i>	black medick	X	
	MEOF	<i>Melilotus officinalis</i>	yellow sweetclover	X	
	OXSE	<i>Oxytropis sericea</i>	white locoweed		
	OXYTR	<i>Oxytropis sp.</i>	locoweed		
	PEAR6	<i>Pedimelum argophyllum</i>	silverleaf Indian breadroot		
	PEES	<i>Pedimelum esculentum</i>	large Indian breadroot		
	PSTE5	<i>Psoralidium tenuiflorum</i>	slimflower scurpea		
	VIAM	<i>Vicia americana</i>	American vetch		
Grossulariaceae	RIAU	<i>Ribes aureum</i>	golden currant		
	RIOX	<i>Ribes oxycanthoides</i>	Canadian gooseberry		
Iridaceae	SIMO2	<i>Sisyrinchium montanum</i>	strict blue-eyed grass		
Lamiaceae	HEHI	<i>Hedeoma hispida</i>	rough false pennyroyal		

Family	Symbol	Scientific Name	Common Name	Exotic	Rare
	MOFI	<i>Monarda fistulosa</i>	wild bergamot		
	SARE3	<i>Salvia reflexa</i>	lanceleaf sage		
Liliaceae	ALLIU	<i>Allium sp.</i>	onion		
	MAST4	<i>Maianthemum stellatum</i>	starry false lily of the valley		
Linaceae	LILE3	<i>Linum lewisii</i>	Lewis flax		
Malvaceae	SPCO	<i>Sphaeralcea coccinea</i>	scarlet globemallow		
Melanthiaceae	TOVE2	<i>Toxicoscordion venenosum</i>	meadow deathcamas		
Onagraceae	OESE3	<i>Oenothera serrulata</i>	yellow sundrops		
	OESU99	<i>Oenothera suffrutescens</i>	scarlet beeblossom		
Oxalidaceae	OXST	<i>Oxalis stricta</i>	common yellow oxalis		
Pinaceae	PIPO	<i>Pinus ponderosa</i>	ponderosa pine		
Plantaginaceae	PLPA2	<i>Plantago patagonica</i>	woolly plantain		
	SYWY99	<i>Synthyris wyomingensis</i>	Wyoming kittentails		
Poaceae	ACHY	<i>Achnatherum hymenoides</i>	Indian ricegrass		
	ANGE	<i>Andropogon gerardii</i>	big bluestem		
	ARPU9	<i>Aristida purpurea</i>	purple threeawn		
	BOCU	<i>Bouteloua curtipendula</i>	sideoats grama		
	BODA2	<i>Bouteloua dactyloides</i>	buffalograss		
	BOGR2	<i>Bouteloua gracilis</i>	blue grama		
	BOHI2	<i>Bouteloua hirsuta</i>	hairy grama		
	BRAN	<i>Bromus anomalus</i>	nodding brome		
	BRIN2	<i>Bromus inermis</i>	smooth brome	X	
	BRJA	<i>Bromus japonicus</i>	Japanese brome	X	
	BRPO2	<i>Bromus porteri</i>	Porter brome		
	BRTE	<i>Bromus tectorum</i>	cheatgrass	X	
	CALO	<i>Calamovilfa longifolia</i>	prairie sandreed		
	DASP2	<i>Danthonia spicata</i>	poverty oatgrass		
	DICHA2	<i>Dichanthelium sp.</i>	rosette grass		
	DILI2	<i>Dichanthelium linearifolium</i>	slimleaf panicgrass		
	DIOL	<i>Dichanthelium oligosanthos</i>	Heller's rosette grass		
	DIWI5	<i>Dichanthelium wilcoxianum</i>	fall rosette grass		
	ELCA4	<i>Elymus canadensis</i>	Canada wildrye		
	ELEL5	<i>Elymus elymoides</i>	squirreltail		
	ELRE4	<i>Elymus repens</i>	quackgrass	X	
	ELTR7	<i>Elymus trachycaulus</i>	slender wheatgrass		
	FESA	<i>Festuca saximontana</i>	Rocky Mountain fescue		
	HECO26	<i>Hesperostipa comata</i>	needle and thread		
	HESP11	<i>Hesperostipa spartea</i>	porcupinegrass		
	KOMA	<i>Koeleria macrantha</i>	prairie Junegrass		
	MUCU3	<i>Muhlenbergia cuspidata</i>	plains muhly		
	MUPA99	<i>Muhlenbergia paniculata</i>	tumblegrass		
	MURA	<i>Muhlenbergia racemosa</i>	marsh muhly		
	NAVI4	<i>Nassella viridula</i>	green needlegrass		
	PASM	<i>Pascopyrum smithii</i>	western wheatgrass		
	PIMI7	<i>Piptatherum micranthum</i>	littleseed ricegrass		
	POCO	<i>Poa compressa</i>	Canada bluegrass	X	
	POPR	<i>Poa pratensis</i>	Kentucky bluegrass	X	

Family	Symbol	Scientific Name	Common Name	Exotic	Rare
	SCSC	<i>Schizachyrium scoparium</i>	little bluestem		
	SONU2	<i>Sorghastrum nutans</i>	Indiangrass		
	SPCR	<i>Sporobolus cryptandrus</i>	sand dropseed		
	SPHE	<i>Sporobolus heterolepis</i>	prairie dropseed		
	VUOC	<i>Vulpia octoflora</i>	sixweeks fescue		
Polemoniaceae	PHAL3	<i>Phlox alyssifolia</i>	alyssumleaf phlox		
	PHAN4	<i>Phlox andicola</i>	prairie phlox		
	PHHO	<i>Phlox hoodii</i>	spiny phlox		
Polygalaceae	POAL4	<i>Polygala alba</i>	white milkwort		
Polygonaceae	POAV	<i>Polygonum aviculare</i>	prostrate knotweed	X	
Primulaceae	ANOC2	<i>Androsace occidentalis</i>	western rockjasmine		
Ranunculaceae	ANCY	<i>Anemone cylindrica</i>	candle anemone		
	ANPA19	<i>Anemone patens</i>	eastern pasqueflower		
	CLLI2	<i>Clematis ligusticifolia</i>	western white clematis		
Rhamnaceae	RHCA3	<i>Rhamnus cathartica</i>	common buckthorn	X	
Rosaceae	AMAL2	<i>Amelanchier alnifolia</i>	Saskatoon serviceberry		
	CEMO2	<i>Cercocarpus montanus</i>	alderleaf mountain mahogany		
	DRAR8	<i>Drymocallis arguta</i>	tall cinquefoil		
	FRVI	<i>Fragaria virginiana</i>	Virginia strawberry		
	GETR	<i>Geum triflorum</i>	old man's whiskers		
	PHMO4	<i>Physocarpus monogynus</i>	mountain ninebark		
	POCO13	<i>Potentilla concinna</i>	elegant cinquefoil		
	POHI6	<i>Potentilla hippiana</i>	woolly cinquefoil		
	POPE8	<i>Potentilla pensylvanica</i>	Pennsylvania cinquefoil		
	PRAM	<i>Prunus americana</i>	American plum		
	PRVI	<i>Prunus virginiana</i>	chokecherry		
	ROAR3	<i>Rosa arkansana</i>	prairie rose		
Rubiaceae	GABO2	<i>Galium boreale</i>	northern bedstraw		
Saxifragaceae	HERI	<i>Heuchera richardsonii</i>	Richardson's alumroot		
Scrophulariaceae	CASE5	<i>Castilleja sessiliflora</i>	downy paintedcup		
	NUTE	<i>Nuttallanthus texanus</i>	Texas toadflax		
	PEAL2	<i>Penstemon albidus</i>	white penstemon		
	PENST	<i>Penstemon sp.</i>	beardtongue		
	VEPE2	<i>Veronica peregrina</i>	neckweed		
	VETH	<i>Verbascum thapsus</i>	common mullein	X	
Selaginellaceae	SEDE2	<i>Selaginella densa</i>	lesser spikemoss		
Solanaceae	PHLO4	<i>Physalis longifolia</i>	longleaf groundcherry		
	PHVI5	<i>Physalis virginiana</i>	Virginia groundcherry		
	SOTR	<i>Solanum triflorum</i>	cutleaf nightshade		
Ulmaceae	ULAM	<i>Ulmus americana</i>	American elm		
Verbenaceae	VEBR	<i>Verbena bracteata</i>	bigbract verbena		
	VEST	<i>Verbena stricta</i>	hoary verbena		
Violaceae	VIOLA	<i>Viola sp.</i>	violet		



Figure 4. Two rare plant species found in plant community monitoring plots at Wind Cave National Park in 2016. Left: Buff fleabane (*Erigeron ochroleucus*), S3/S4. Right: Nylon hedgehog cactus (*Echinocereus viridiflorus*), S3.

The total number of plant species observed in each plot was compiled using point-intercept, quadrat, and target species data (Table 8). The plot with the greatest species diversity, with a total of 61 species identified, was WICA_PCM_0034. This plot, located in the northwest part of the park, also had the greatest number of native species compared to all the other plots with 53 species observed. In contrast, the two plots with the greatest number of exotic plant species, with ten species each, were WICA_PCM_0033, located in an open upland grassland area frequented by bison in the west central part of the park, and WICA_PCM_0029, a plot in a historic burn area in the northwest part of the park.

Absolute and relative covers were calculated using point-intercept data (Table 9). Plot WICA_PCM_0007 is the most native by relative cover, with 100% native cover. The plot with the highest absolute cover of native species, as well as the highest total absolute cover, is WICA_PCM_2050. In comparison, WICA_PCM_0120 has the greatest relative cover of exotic species with 58%, and WICA_PCM_0033 has the greatest absolute cover of exotic species with 90%.

NGPFire found a total of seven different common exotic species in 20 plots surveyed (Table 10). All of the brome grass species on the search list (Table 5) were located. Cheatgrass was only found in one plot, WICA_PCM_0317. The plant species with the greatest cover was common mullein, with the most located in WICA_PCM_0952. No exotic species were found in WICA_PCM_0080.

Table 8. Number of plant species per plot observed in 38 plots at Wind Cave National Park in 2016. (/** Plot read by NGPFire. *=Data summarized from only point-intercept and target species survey methods.**=Data only collected via target species survey method.)

Plot Name	Exotic (Number of Species)	Native (Number of Species)	Total Number of Species
WICA_FPCM_0220*	5	19	24
WICA_FPCM_0268*	3	15	18
WICA_FPCM_0317*	8	13	21
WICA_FPCM_0353*	6	16	22
WICA_FPCM_0504*	5	17	22
WICA_FPCM_0524*	5	12	17

Plot Name	Exotic (Number of Species)	Native (Number of Species)	Total Number of Species
WICA_FPCM_0588*	6	14	20
WICA_FPCM_0737*	5	10	15
WICA_FPCM_0796*	6	15	21
WICA_FPCM_0952*	4	11	15
WICA_PCM_0001	5	30	35
WICA_PCM_0002	4	40	44
WICA_PCM_0004	6	34	40
WICA_PCM_0005	3	48	51
WICA_PCM_0006	7	49	56
WICA_PCM_0007	2	20	22
WICA_PCM_0016**	2	0	2
WICA_PCM_0021**	1	0	1
WICA_PCM_0029	10	40	50
WICA_PCM_0030	9	34	43
WICA_PCM_0031	4	49	53
WICA_PCM_0032	9	28	37
WICA_PCM_0033	10	41	51
WICA_PCM_0034	8	53	61
WICA_PCM_0035	1	37	38
WICA_PCM_0036	3	38	41
WICA_PCM_0046**	4	1	5
WICA_PCM_0076*	7	17	24
WICA_PCM_0080**	0	0	0
WICA_PCM_0094**	2	2	4
WICA_PCM_0110**	3	3	6
WICA_PCM_0120*	6	11	17
WICA_PCM_2050	6	44	50
WICA_PCM_2051	8	45	53
WICA_PCM_2053**	1	1	2
WICA_PCM_2056**	1	1	2
WICA_PCM_2058	3	38	41
WICA_PCM_2059	3	37	40

Table 9. Absolute and relative cover of native and exotic species in 30 plots monitored in 2016 at Wind Cave National Park, calculated using point-intercept data. Absolute cover includes overlapping species canopies and can be greater than 100%. (*NGPFire plot visits)

Plot Name	Absolute Cover (%)		Relative Cover (%)	
	Native	Exotic	Native	Exotic
WICA_FPCM_0220*	69	32	68	32
WICA_FPCM_0268*	61	39	61	39
WICA_FPCM_0317*	58	28	67	33
WICA_FPCM_0353*	59	15	80	20
WICA_FPCM_0504*	51	14	78	22
WICA_FPCM_0524*	61	49	55	45
WICA_FPCM_0588*	50	36	58	42
WICA_FPCM_0737*	50	51	50	50
WICA_FPCM_0796*	77	12	87	13
WICA_FPCM_0952*	46	2	96	4
WICA_PCM_0002	64	2	97	3
WICA_PCM_0004	106	48	69	31
WICA_PCM_0005	146	3	98	2
WICA_PCM_0006	183	23	89	11
WICA_PCM_0007	21	0	100	0
WICA_PCM_0029	112	61	65	35
WICA_PCM_0030	113	34	77	23
WICA_PCM_0031	149	40	79	21
WICA_PCM_0032	129	55	70	30
WICA_PCM_0033	158	90	64	36
WICA_PCM_0034	105	72	59	41
WICA_PCM_0035	188	49	79	21
WICA_PCM_0036	152	58	72	28
WICA_PCM_0076*	47	39	55	45
WICA_PCM_0120*	16	22	42	58
WICA_PCM_2050	222	52	81	19
WICA_PCM_2051	131	36	78	22
WICA_PCM_2058	183	8	96	4
WICA_PCM_2059	155	3	98	2

Table 10. List of common exotic target species present in plots surveyed by NGPFire at Wind Cave National Park in 2016 following a Fall 2014 prescribed fire and Spring 2015 prescribed/wildland fire. An abundance class was given on a scale from 1-5 where 1 = one individual, 2 = few individuals, 3 = cover of 1-5%, 4 = cover of 5-25%, and 5 = cover > 25% of the plot.

Plot Name	Burn Date	Plot Burn Severity Rating	Common Name	Abundance Class
WICA_FPCM_0220	10/23/14	Low	Japanese brome	2
WICA_FPCM_0220	10/23/14	Low	Hounds tongue	1
WICA_FPCM_0220	10/23/14	Low	Common mullein	2
WICA_FPCM_0268	10/23/14	Low	Common mullein	2
WICA_FPCM_0317	10/23/14	Low	Smooth brome	2
WICA_FPCM_0317	10/23/14	Low	Japanese brome	2
WICA_FPCM_0317	10/23/14	Low	Cheatgrass	2
WICA_FPCM_0317	10/23/14	Low	Canada thistle	2
WICA_FPCM_0317	10/23/14	Low	Hounds tongue	1
WICA_FPCM_0317	10/23/14	Low	Common mullein	2
WICA_FPCM_0353	10/23/14	Unburned	Canada thistle	2
WICA_FPCM_0353	10/23/14	Unburned	Bullthistle	2
WICA_FPCM_0353	10/23/14	Unburned	Hounds tongue	2
WICA_FPCM_0353	10/23/14	Unburned	Common mullein	2
WICA_FPCM_0504	10/23/14	Low	Canada thistle	2
WICA_FPCM_0504	10/23/14	Low	Common mullein	3
WICA_FPCM_0524	4/13/15	Low	Bullthistle	2
WICA_FPCM_0524	4/13/15	Low	Hounds tongue	2
WICA_FPCM_0588	4/13/15	Low	Smooth brome	2
WICA_FPCM_0588	4/13/15	Low	Bullthistle	1
WICA_FPCM_0588	4/13/15	Low	Hounds tongue	2
WICA_FPCM_0588	4/13/15	Low	Common mullein	2
WICA_FPCM_0737	10/23/14	Scorch	Bullthistle	2
WICA_FPCM_0737	10/23/14	Scorch	Hounds tongue	2
WICA_FPCM_0737	10/23/14	Scorch	Common mullein	2
WICA_FPCM_0796	4/13/15	Moderate	Japanese brome	2
WICA_FPCM_0796	4/13/15	Moderate	Canada thistle	2
WICA_FPCM_0796	4/13/15	Moderate	Bullthistle	2
WICA_FPCM_0796	4/13/15	Moderate	Common mullein	2
WICA_FPCM_0952	4/13/15	Moderate	Canada thistle	2
WICA_FPCM_0952	4/13/15	Moderate	Bullthistle	2
WICA_FPCM_0952	4/13/15	Moderate	Common mullein	3
WICA_PCM_0016	4/13/15	Scorch	Smooth brome	3
WICA_PCM_0016	4/13/15	Scorch	Bullthistle	1
WICA_PCM_0021	4/13/15	Low	Japanese brome	2
WICA_PCM_0046	4/13/15	Low	Japanese brome	2

Plot Name	Burn Date	Plot Burn Severity Rating	Common Name	Abundance Class
WICA_PCM_0046	4/13/15	Low	Canada thistle	2
WICA_PCM_0046	4/13/15	Low	Hounds tongue	2
WICA_PCM_0046	4/13/15	Low	Common mullein	2
WICA_PCM_0076	4/13/15	Low	Canada thistle	2
WICA_PCM_0076	4/13/15	Low	Hounds tongue	2
WICA_PCM_0076	4/13/15	Low	Common mullein	2
WICA_PCM_0094	4/13/15	Low	Japanese brome	2
WICA_PCM_0094	4/13/15	Low	Common mullein	2
WICA_PCM_0110	4/13/15	Scorch	Canada thistle	2
WICA_PCM_0110	4/13/15	Scorch	Hounds tongue	2
WICA_PCM_0110	4/13/15	Scorch	Common mullein	2
WICA_PCM_0120	4/13/15	Scorch	Japanese brome	2
WICA_PCM_0120	4/13/15	Low	Canada thistle	2
WICA_PCM_0120	4/13/15	Low	Bullthistle	2
WICA_PCM_0120	4/13/15	Low	Common mullein	2
WICA_PCM_2053	4/13/15	Scorch	Japanese brome	2
WICA_PCM_2056	4/13/15	Unburned	Japanese brome	2

Live trees and seedlings were present in 28 of 38 plots visited in 2016 (Table 11). Data collected included species name, size class based on diameter at breast height (DBH), status, total number of individuals, and density per hectare. DBH categories are tree (DBH>15 cm), pole (2.54 cm<DBH>15 cm), and seedling (DBH<2.54 cm). Tree health for each individual tree was also observed, and most common damages included burn damage, cambium damage, and broken tops. Mountain pine beetle damage was found on one live Ponderosa pine in WICA_PCM_0353. Ponderosa pine seedlings were found in 17 of the 28 plots. Tree regeneration, based on seedling density, was greatest in WICA_FPCM_0353. A more thorough assessment of forest structure was completed in 2012 (Ashton et al. 2013), and is scheduled to be repeated in 2017.

Dead and downed wood, and surface fuels, provide foraging habitat and refugia for small wildlife species, as well as substrate for mosses and fungi. Downed wood sometimes also provides “nursery” logs for vascular plant establishment. However, when surface fuels are too abundant in a forest they can increase the risk of high intensity fires. The NGP Fire Effects Program has developed a management target for surface fuels: the goal is to keep a range between 2 and 10 tons per acre within the Black Hills parks. NGPN and NGPFire surveyed for and measured surface fuels in 30 plots (Table 12). The fuels are listed as all zeros in three plots because they are grassland plots and contained no measureable woody fuels.

Disturbances occurred in fifteen out of eighteen plant community monitoring plots at WICA visited by the NGPN monitoring crew in 2016 (Table 13). The most common disturbance types observed were animal use (e.g., trails, grazing, and trampled or missing vegetation), and fire signs, which were often most noticeable as char and scars on trees. No disturbance data were collected at plots visited by NGPFire.

Table 11. Woody species data from 28 plots visited at Wind Cave National Park in 2016. DBH categories are tree (DBH>15 cm), pole (2.54 cm<DBH>15 cm), and seedling (DBH<2.54 cm).

Plot Name	Common Name	DBH	Status	Density/ha.
WICA_FPCM_0220	Ponderosa pine	Seedling	Live	572.88
WICA_FPCM_0220	Ponderosa pine	Pole	Dead	254.78
WICA_FPCM_0220	Ponderosa pine	Pole	Live	63.69
WICA_FPCM_0220	Ponderosa pine	Tree	Dead	31.85
WICA_FPCM_0220	Ponderosa pine	Tree	Live	191.08
WICA_FPCM_0268	Ponderosa pine	Seedling	Live	318.27
WICA_FPCM_0268	Ponderosa pine	Pole	Live	10
WICA_FPCM_0268	Ponderosa pine	Tree	Live	100
WICA_FPCM_0317	Ponderosa pine	Seedling	Live	63.65
WICA_FPCM_0317	Ponderosa pine	Tree	Dead	31.85
WICA_FPCM_0317	Ponderosa pine	Tree	Live	286.62
WICA_FPCM_0353	Ponderosa pine	Seedling	Live	21896.88
WICA_FPCM_0353	Ponderosa pine	Pole	Live	127.39
WICA_FPCM_0353	Ponderosa pine	Tree	Live	605.1
WICA_FPCM_0504	Ponderosa pine	Pole	Dead	31.85
WICA_FPCM_0504	Ponderosa pine	Tree	Dead	31.85
WICA_FPCM_0504	Ponderosa pine	Tree	Live	318.47
WICA_FPCM_0524	Ponderosa pine	Pole	Dead	222.93
WICA_FPCM_0524	Ponderosa pine	Pole	Live	222.93
WICA_FPCM_0524	Ponderosa pine	Tree	Dead	31.85
WICA_FPCM_0524	Ponderosa pine	Tree	Live	605.1
WICA_FPCM_0588	Ponderosa pine	Pole	Dead	159.24
WICA_FPCM_0588	Ponderosa pine	Pole	Live	159.24
WICA_FPCM_0588	Ponderosa pine	Tree	Dead	127.39
WICA_FPCM_0588	Ponderosa pine	Tree	Live	414.01
WICA_FPCM_0737	Ponderosa pine	Seedling	Live	2737.11
WICA_FPCM_0737	Ponderosa pine	Pole	Live	191.08
WICA_FPCM_0737	Ponderosa pine	Tree	Live	382.17
WICA_FPCM_0796	Ponderosa pine	Pole	Dead	318.47
WICA_FPCM_0796	Ponderosa pine	Tree	Dead	318.47
WICA_FPCM_0796	Ponderosa pine	Tree	Live	31.85
WICA_FPCM_0952	Ponderosa pine	Pole	Dead	2547.77
WICA_FPCM_0952	Ponderosa pine	Tree	Dead	382.17
WICA_PCM_0001	American elm	Seedling	Live	4667.94
WICA_PCM_0002	Ponderosa pine	Seedling	Live	5792.49
WICA_PCM_0002	Ponderosa pine	Tree	Dead	10
WICA_PCM_0002	Ponderosa pine	Tree	Live	90
WICA_PCM_0005	Ponderosa pine	Tree	Live	10
WICA_PCM_0007	Alderleaf mountain mahogany	Seedling	Live	31.83

Plot Name	Common Name	DBH	Status	Density/ha.
WICA_PCM_0007	Ponderosa pine	Seedling	Live	509.23
WICA_PCM_0007	Ponderosa pine	Pole	Dead	541.4
WICA_PCM_0007	Ponderosa pine	Pole	Live	1751.59
WICA_PCM_0007	Ponderosa pine	Pole	Live	50
WICA_PCM_0007	Ponderosa pine	Tree	Live	620
WICA_PCM_0029	Ponderosa pine	Seedling	Live	1050.29
WICA_PCM_0029	Ponderosa pine	Tree	Dead	50
WICA_PCM_0030	Saskatoon serviceberry	Seedling	Live	63.65
WICA_PCM_0030	Rocky Mountain juniper	Seedling	Live	1941.44
WICA_PCM_0030	Ponderosa pine	Seedling	Live	10502.86
WICA_PCM_0030	Chokecherry	Seedling	Live	2482.5
WICA_PCM_0030	Common buckthorn	Seedling	Live	31.83
WICA_PCM_0030	Rocky Mountain juniper	Pole	Live	732.48
WICA_PCM_0030	Ponderosa pine	Pole	Live	63.69
WICA_PCM_0030	Rocky Mountain juniper	Tree	Live	130
WICA_PCM_0030	Ponderosa pine	Tree	Dead	10
WICA_PCM_0030	Ponderosa pine	Tree	Live	360
WICA_PCM_0034	Ponderosa pine	Seedling	Live	7447.49
WICA_PCM_0034	Ponderosa pine	Tree	Dead	10
WICA_PCM_0034	Ponderosa pine	Tree	Live	60
WICA_PCM_0035	Rocky Mountain juniper	Seedling	Live	31.83
WICA_PCM_0035	Ponderosa pine	Seedling	Live	1814.13
WICA_PCM_0035	Ponderosa pine	Pole	Live	1082.8
WICA_PCM_0035	Ponderosa pine	Pole	Live	20
WICA_PCM_0035	Ponderosa pine	Tree	Live	90
WICA_PCM_0046	Ponderosa pine	Pole	Dead	2356.69
WICA_PCM_0046	Ponderosa pine	Pole	Live	222.93
WICA_PCM_0046	Ponderosa pine	Tree	Dead	63.69
WICA_PCM_0046	Ponderosa pine	Tree	Live	318.47
WICA_PCM_0076	Ponderosa pine	Seedling	Live	381.92
WICA_PCM_0076	Ponderosa pine	Seedling	Live	1400.38
WICA_PCM_0076	Ponderosa pine	Pole	Dead	63.69
WICA_PCM_0076	Ponderosa pine	Tree	Dead	222.93
WICA_PCM_0076	Ponderosa pine	Tree	Live	286.62
WICA_PCM_0094	Chokecherry	Seedling	Live	1941.44
WICA_PCM_0094	Ponderosa pine	Pole	Dead	668.79
WICA_PCM_0094	Ponderosa pine	Tree	Dead	31.85
WICA_PCM_0094	Ponderosa pine	Tree	Live	31.85
WICA_PCM_0110	Chokecherry	Seedling	Live	5092.3
WICA_PCM_0110	Rocky Mountain juniper	Pole	Dead	31.85
WICA_PCM_0110	Ponderosa pine	Pole	Live	222.93

Plot Name	Common Name	DBH	Status	Density/ha.
WICA_PCM_0110	Ponderosa pine	Tree	Live	222.93
WICA_PCM_0120	Ponderosa pine	Pole	Dead	254.78
WICA_PCM_0120	Ponderosa pine	Pole	Live	63.69
WICA_PCM_0120	Ponderosa pine	Tree	Live	159.24
WICA_PCM_2051	Rocky Mountain juniper	Seedling	Live	509.23
WICA_PCM_2051	Ponderosa pine	Seedling	Live	445.58
WICA_PCM_2051	Chokecherry	Seedling	Live	3628.26
WICA_PCM_2051	Common buckthorn	Seedling	Live	63.65
WICA_PCM_2051	American elm	Seedling	Live	509.23
WICA_PCM_2051	Rocky Mountain juniper	Pole	Live	509.55
WICA_PCM_2051	Chokecherry	Pole	Dead	127.39
WICA_PCM_2051	American elm	Pole	Live	254.78
WICA_PCM_2051	Rocky Mountain juniper	Tree	Live	20
WICA_PCM_2051	Ponderosa pine	Tree	Live	120
WICA_PCM_2053	Ponderosa pine	Seedling	Live	31.83
WICA_PCM_2053	Ponderosa pine	Pole	Live	31.85
WICA_PCM_2053	Ponderosa pine	Tree	Live	31.85
WICA_PCM_2056	Rocky Mountain juniper	Seedling	Live	31.83
WICA_PCM_2058	Ponderosa pine	Seedling	Live	222.79
WICA_PCM_2058	Ponderosa pine	Pole	Live	95.54
WICA_PCM_2058	Ponderosa pine	Tree	Live	40
WICA_PCM_2059	Rocky Mountain juniper	Seedling	Live	286.44
WICA_PCM_2059	Ponderosa pine	Seedling	Live	63.65
WICA_PCM_2059	Chokecherry	Seedling	Live	4413.32
WICA_PCM_2059	American elm	Seedling	Live	31.83
WICA_PCM_2059	Rocky Mountain juniper	Pole	Live	732.48
WICA_PCM_2059	Ponderosa pine	Pole	Live	63.69
WICA_PCM_2059	Rocky Mountain juniper	Tree	Live	40

Table 12. Surface fuels summary for 30 plots visited at Wind Cave National Park by NGPN and NGPFire (*) monitoring crews in 2016.

Plot Name	Average Tons per Acre										Avg. Depth (in.)		
	1-hr	10-hr	100-hr	1-100-hr	1000-hr sound	1000-hr rotten	1-1000-hr	Duff	Litter	Total	Duff	Litt	Total
WICA_FPCM_0220*	0.00	0.14	1.45	1.59	0.00	0.00	1.59	6.25	0.46	8.30	0.4	0.1	0.5
WICA_FPCM_0268*	0.02	0.95	0.00	0.97	0.24	0.30	1.51	4.75	0.60	6.86	0.3	0.2	0.4
WICA_FPCM_0317*	0.00	0.14	0.00	0.14	9.26	0.00	9.39	3.96	1.00	14.35	0.2	0.3	0.5
WICA_FPCM_0353*	0.02	0.42	0.73	1.17	1.07	3.61	5.85	9.95	1.28	17.07	0.6	0.3	0.9
WICA_FPCM_0504*	0.00	0.41	0.77	1.18	0.45	0.00	1.63	1.41	0.32	3.36	0.1	0.1	0.2
WICA_FPCM_0524*	0.02	0.41	0.00	0.43	3.41	0.72	4.55	4.84	0.92	10.31	0.3	0.2	0.5
WICA_FPCM_0588*	0.04	0.27	0.73	1.04	1.36	0.00	2.40	2.73	0.96	6.08	0.2	0.2	0.4
WICA_FPCM_0737*	0.00	0.81	8.81	9.62	6.82	5.90	22.34	12.85	1.64	36.83	0.7	0.4	1.1
WICA_FPCM_0796*	0.02	0.00	0.00	0.02	0.00	0.00	0.02	0.44	1.04	1.50	0.0	0.3	0.3
WICA_FPCM_0952*	0.08	0.00	0.00	0.08	2.85	0.00	2.93	0.26	0.58	3.78	0.0	0.1	0.2
WICA_PCM_0001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
WICA_PCM_0002	0.00	0.14	0.00	0.14	0.00	5.04	5.18	7.75	1.32	14.24	0.4	0.3	0.8
WICA_PCM_0005	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.68	0.68	0.0	0.2	0.2
WICA_PCM_0007	0.14	1.10	0.00	1.24	0.00	2.67	3.91	18.49	3.79	26.18	1.1	1.0	2.0
WICA_PCM_0029	0.00	1.51	0.74	2.26	0.86	0.00	3.12	5.55	2.46	11.12	0.3	0.6	0.9
WICA_PCM_0030	0.02	0.00	0.73	0.75	0.00	2.05	2.80	14.52	3.25	20.58	0.8	0.8	1.6
WICA_PCM_0031	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
WICA_PCM_0034	0.04	0.28	2.90	3.22	0.64	0.00	3.86	2.82	5.35	12.03	0.2	1.3	1.5
WICA_PCM_0035	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	1.42	2.12	0.0	0.4	0.4
WICA_PCM_0036	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
WICA_PCM_0046*	0.10	0.54	0.00	0.64	0.00	0.00	0.64	2.82	0.90	4.36	0.2	0.2	0.4
WICA_PCM_0076*	0.04	0.54	0.00	0.58	2.16	0.86	3.60	1.94	0.52	6.06	0.1	0.1	0.2
WICA_PCM_0094*	0.10	0.41	0.00	0.51	13.30	3.40	17.22	1.23	0.32	18.77	0.1	0.1	0.2
WICA_PCM_0110*	0.02	0.29	6.65	6.96	0.00	0.00	6.96	0.00	0.20	7.16	0.0	0.1	0.1
WICA_PCM_0120*	0.02	0.41	0.00	0.43	0.00	0.00	0.43	4.75	1.24	6.42	0.3	0.3	0.6
WICA_PCM_2051	0.10	0.27	0.00	0.37	0.25	5.76	6.38	9.07	4.07	19.52	0.5	1.0	1.5
WICA_PCM_2053*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.06	0.24	0.0	0.0	0.0
WICA_PCM_2056*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
WICA_PCM_2058	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.94	6.71	8.64	0.1	1.7	1.8
WICA_PCM_2059	0.12	1.86	0.00	1.98	0.34	0.00	2.33	4.73	5.27	12.33	0.2	0.7	0.9

Table 13. Disturbance types and area sizes observed in fifteen plots visited at Wind Cave National Park in 2016. The size was approximated, and out of a total area of 1000 m².

Plot Name	Disturbance Type	Size (m ²)
WICA_PCM_0001	Animal Trail	60
	Grazing	150
WICA_PCM_0002	Fire (Wildland)	1000
WICA_PCM_0004	Grazing	1000
	Prairie Dog	1000
WICA_PCM_0005	Fire (Prescribed)	1
WICA_PCM_0006	Off-Road (old tracks)	500
	Grazing	5
WICA_PCM_0007	Animal Use (Elk)	3
WICA_PCM_0029	Grazing	150
	Fire (Wildland)	750
	Storm	50
WICA_PCM_0030	Animal Trail	15
WICA_PCM_0031	Animal Trail	30
	Grazing	20
WICA_PCM_0032	Animal Trail	5
	Prairie Dog	250
WICA_PCM_0033	Grazing	1
WICA_PCM_0034	Grazing	5
	Storm	10
WICA_PCM_0036	Animal Trail	7
WICA_PCM_2051	Animal Trail	50
WICA_PCM_2059	Animal Trail	30
	Grazing	5
	Trash (Human Use)	5

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